ORIGINAL

BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite ("GMPCS") Memorandum of Understanding and Arrangements	)	IB Docket No. 99-67
	)	
Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band	)	RM No. 9165

To: The Commission

COMMENTS OF THE U.S. GPS INDUSTRY COUNCIL

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SUMMARY

The U.S. GPS Industry Council ("the Council"), by its attorneys, hereby comments on the Commission's notice of proposed rule making ("*NPRM*") in the above-captioned proceeding. The Commission's *NPRM* proposes limitation on out-of-band emissions ("OOBE") into the 1559-1605 MHz band from mobile earth terminals ("METs") associated with mobile-satellite service ("MSS") systems that operate or are to operate in the 1-3 GHz frequency range. The 1559-1605 MHz band is used by radionavigation-satellite service ("RNSS") systems such as the U.S. Global Positioning System ("GPS"), which has millions of users worldwide in a wide variety of safety and non-safety related applications.

In these Comments, the Council explains why the –70 dBW/MHz OOBE level that the Commission proposes as a "final," post-2004 wideband OOBE limit for the 1559-1605 MHz band has been shown to be appropriate only as applicable to OOBE from METs operating with 1-3 GHz MSS systems (due to complementarities between GPS and such MSS operators, and the necessary operational relationship that exists in these limited cases). The Council goes on to explain that, in the absence of specific studies that address critical subjects including the particular operational characteristics, interservice and intraservice aggregate interference levels, the impact of harmonic emissions, separation distances, and shielding, the –70 dBW/MHz level on wideband OOBE into the GPS band cannot rationally be extended to any other types of emitters, regardless of where in the frequency spectrum such emitters may be located.

The Council provides, for the first time, technical studies showing the impact that operation of even a single emitter at a –70 dBW/MHz OOBE level in the GPS band would have

on GPS receivers of the types in use today. Using a target standard of "co-location" of the noise source and the GPS receiver, which standard generously called for operation of the noise source at a distance of up to one meter from the GPS receiver, results showed that at the –70 dBW/MHz level, not one tested receiver would be able to obtain a position fix from GPS satellites. Indeed, receivers started losing the ability to track GPS satellites at distances on the order of 90 feet from the noise source. The Council's test show that only after the noise source was limited to a level of –100 dBW/MHz would the co-location standard be able to be met. As was to be expected, adding multiple emitters significantly exacerbated the interference threat.

The bottom line from the tests is that the –70 dBW/MHz level is clearly not a protection criterion for GPS. As a result, the Commission must clearly state that the –70 dBW/MHz OOBE level for 1-3 GHz MSS METs cannot be extended to any other service without independent study and verification of suitability. To the extent that it may be desirable for the Commission to adopt a "default" OOBE threshold level at which emitters other than 1-3 GHz MSS METs would be able to operate without undergoing independent study, the threshold needs to be based on a co-location standard (*i.e.*, the noise source would be one meter or less from the GPS receiver) due to the ubiquity of GPS use. Under this circumstance, the maximum appropriate level for this OOBE threshold in the 1559-1605 MHz band is –100 dBW/MHz.

Recognizing that the –70 dBW/MHz level for 1-3 GHz MSS METs is made acceptable only by the complementary relationship between the affected services and that an operational solution must be found, it is emphatically clear that the Commission's proposal that "Big LEO" MSS earth terminals that are placed in service before 2002 may meet, until January 1, 2005, an interim limit of –64 dBW/MHz on wideband emissions in the band 1580.42-1605 MHz and an

interim limit of –74 dBW on narrowband emissions in the band 1585.42-1605 MHz, must be rejected. If -70 dBW/MHz were the maximum allowable emissions standard, there clearly would be interference from emitters that operate in the same bands at levels greater than –70 dBW/MHz. There is no rational basis either for allowing a higher interim interference level or for limiting the bands within which protection from wideband OOBE is provided to a band that does not reflect today's GPS operations.

With respect to the appropriate OOBE levels for emitters other than 1-3 GHz MSS METs, the Council urges the Commission to adopt OOBE levels for particular emitters on a case-by-case basis, where specific, credible studies have been conducted considering all the relevant factors. To the extent that it may be desirable for the Commission to adopt a "default" OOBE threshold level at which emitters other than 1-3 GHz MSS METs would be able to provide OOBE into the GPS band (fully 1559-1605 MHz) without undergoing independent study, the threshold needs to be based on a co-location standard (*i.e.*, the noise source would be one meter or less from the GPS receiver) due to the ubiquity of GPS use. Under this circumstance, the Council's data reveal that the appropriate level for this OOBE threshold in the 1559-1605 MHz band is –100 dBW/MHz.

Only by embracing the essential qualifications the Council seeks in these Comments, can the Commission adopt OOBE limitations and associated policy decisions that both satisfy its obligation to ensure the protection of all uses of GPS and advance its objective of facilitating the establishment of a successful and competitive 1-3 GHz MSS industry.

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In the Matter of	)	
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Amendment of Parts 2 and 25 to Implement	)	IB Docket No. 99-67
the Global Mobile Personal Communications	)	
by Satellite ("GMPCS") Memorandum of	)	
Understanding and Arrangements	)	
	)	
Petition of the National Telecommunications and	)	RM No. 9165
Information Administration to Amend Part 25	)	
of the Commission's Rules to Establish Emissions	)	
Limits for Mobile and Portable Earth Stations	)	
Operating in the 1610-1660.5 MHz Band	)	

To: The Commission

COMMENTS OF THE U.S. GPS INDUSTRY COUNCIL

The U.S. GPS Industry Council ("the Council"), by its attorneys and pursuant to Sections 1.415 and 1.419 of the Commission's rules,[1] hereby comments on the Commission's notice of proposed rule making in the above-captioned proceeding.[2] In a gesture of goodwill and the spirit of compromise, the Council earlier this year led the drive to establish, as a position of the United States in the study groups of the International Telecommunication Union ("ITU"), an out-of-band emission limitation of –70 dBW/MHz in the band 1559-1605 MHz for wideband

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[1] 47 C.F.R. §§ 1.415 and 1.419.

[2] See Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite ("GMPCS") Memorandum of Understanding and Arrangements; Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Station Operating in the 1610-1660.5 MHz Band, IB Docket No. 99-67 (RM No. 9165) (FCC 99-37) (released March 5, 1999) ("NPRM").

emissions from mobile-satellite service ("MSS") earth terminals operating in the frequency bands 1610-1660.5 MHz.[3] Although the –70 dBW/MHz limitation would not protect radionavigation satellite service ("RNSS") receivers operating at 1559-1605 MHz in many of the applications (safety of life and otherwise) for which they are used, the Council recognized that there is a complementary relationship between the RNSS and 1-3 GHz MSS that provides MSS operators with the necessary incentives to ensure that their associated earth terminals are operated in a way that protects RNSS receivers from harmful interference.[4] As a result, the Council and the United States were prepared to accept the –70 dBW/MHz limitation on out-of-band emission levels produced by 1-3 GHz band MSS earth terminals. At the same time, however, the Council and the United States made it very clear that the –70 dBW/MHz limitation (which is reflected in ITU Radiocommunication Assembly ("ITU-R") Recommendation M.1343) may not be applied to any emitters other than MSS mobile earth terminals ("METs") associated with MSS systems in the 1-3 GHz range unless studies have been successfully completed that address critical subjects including interservice and intraservice aggregate interference levels, the impact of harmonic emissions, separation distances, and shielding.[5]

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[3] *See* ITU Document 8D/210 (4 March 1999), a contribution of the United States to ITU-R Working Party 8D.

[4] Specifically, as noted in Document 8D/210, MSS systems use RNSS (in particular, the U.S. RNSS system known as the Global Positioning System or GPS) for position determination, timing, and other system functions.

[5] *See* ITU-R Document 8D/210, at 2. This position was reflected in output materials (including a preliminary draft new recommendation on technical characteristics for MSS mobile earth terminals that would operate in the band 1626.5-1660.5 MHz) from the April 1999 meeting of Working Party 8D.

The Council reaffirms its adherence to the position taken by the United States in ITU-R Working Party 8D on the –70 dBW/MHz issue. This was a very constructive compromise that stands to permit the removal of a cloud that has been looming over both the Global Positioning System ("GPS") and MSS operations for some time now. Unfortunately, the Commission's *NPRM* does not correlate well with the more subtle and advanced position that has developed on this issue over the last two years, and thus represents a large and dangerous step in the wrong direction. The Commission's proposals, if implemented, would eviscerate GPS and endanger countless lives and livelihoods in the process. The proposals simply cannot be adopted in their present form. Instead, the Commission should expressly embrace the compromise solution struck earlier this year and adopt rules and policies that bring that solution into permanent effect.

I. INTRODUCTION

In its *NPRM*, the Commission proposes, among other things, to adopt out-of-band emission limits for Global Mobile Personal Communications by Satellite ("GMPCS") earth terminals transmitting in the MSS bands 1610-1660.5 MHz in order to protect the reception of aeronautical RNSS signals in the 1559-1605 MHz band.[6] Specifically, the Commission proposes to require MSS earth terminals that are placed in service on or after January 1, 2002 in the bands 1610-1660.5 MHz to suppress the e.i.r.p. density of wideband emissions to –70 dBW/MHz or less in the band 1559-1605 MHz and to suppress the e.i.r.p. of discrete emissions of less than 700

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[6] *NPRM*, FCC 99-37, slip op. at 4 (¶ 5).

Hz bandwidth (i.e., narrowband emissions) to –80 dBW in the same band.[7] The Commission further proposes that, as of January 1, 2005, the limits on both wideband and narrowband emissions in the 1559-1605 MHz band would also apply to MSS terminals transmitting on frequencies between 1610 and 1660.5 MHz that are placed in service *before* 2002.[8] In the interim – *i.e.*, prior to January 1, 2005 – MSS METs terminals placed in service before January 1, 2002 in the band 1626.5-1660.5 MHz would have to meet the –70 dBW/MHz limit on emissions in the band 1559-1580.42 MHz and would have to meet the –80 dBW/MHz narrowband limit on emissions in the band 1559-1585.42 MHz.[9] Finally, the Commission proposes that "Big LEO" MSS earth terminals (*i.e.*, MSS transmitting earth terminals operating with non-geostationary MSS systems on assigned frequencies in the band 1610-1626.5 MHz) that are placed in service before 2002 may, until January 1, 2005, meet an interim limit of –64 dBW/MHz on wideband emissions in the band 1580.42-1605 MHz and an interim limit of –74 dBW on narrowband emissions in the band 1585.42-1605 MHz.[10]

The Commission states that its proposals are based on recommendations made by the National Telecommunications and Information Administration ("NTIA") in a September 1997 petition for rule making that is now part of this proceeding.[11] That fact is directly

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7 *Id.* at 27 (¶ 62).

8 *Id.*

9 *Id.*

10 *Id.*

11 *Id.* at 26 (¶ 61).

responsible for the principal shortcoming of the *NPRM*, in that the NTIA petition was focused exclusively on "approach, landing and surface operations" of aircraft.[12]

As the Council demonstrates below, the Commission's proposal will result in harmful interference to GPS, the U.S. RNSS system and the U.S. component of the Global Navigation Satellite System ("GNSS"), provides critical navigation and safety of life services – aeronautical, maritime, and land-based – to millions of users around the world using, *inter alia*, the 1559-1610 MHz frequency band.[13] The final (*i.e.*, post 2005) out-of-band emission ("OOBE") levels proposed by NTIA were developed for a very specific interference scenario -- *i.e.*, where there was a 100 foot separation between the GPS receiver and the MSS terminal; where the GPS antenna was located on the top of an airplane fuselage and pointed up toward the satellites; and where the MSS terminal is a single, ground-based, omnidirectional transmitter.[14] The NTIA OOBE levels were not intended to be applied for the protection of GPS receivers used in non-aeronautical scenarios or even in other aeronautical scenarios, and there is no proof

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[12] Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band, RM-9165 (page 1 of enclosure) (filed September 1997) ("NTIA Petition for Rule Making").

[13] A September 1998 Report issued by the International Trade Administration, Office of Telecommunications, and Department of Commerce, reported an estimated commercial installed base of more than 3 million GPS users, and worldwide production of 250,000 GPS units each month. By the year 2000, the GPS user community was expected to be adding 2 million users per month. *See Global Positioning System, Market Projections and Trends in the Newest Global Information Utility*, at 26-27.

[14] *See* "Assessment of Radio Frequency Interference Relevant to the GNSS," Document No. RTCA/DO-235 (January 27,1997).

whatsoever that the NTIA criteria are effective in situations where all three of the conditions above do not exist. In fact, the Council shows here that the proposed levels do not protect GPS receivers (many of which are used in public safety RNSS applications) that are operated in close proximity to GMPCS MSS terminals. Continuity is an operational requirement for a broad range of commercial and public safety users of GPS. Close proximity interference to GPS receivers at any of the levels proposed in the *NPRM* would end the continuous availability of GPS.

GPS receivers are used in ambulances, police cars, fire engines, for harbor-harbor entrance navigation, search and rescue, and docking of large marine vessels, such as oil tankers and high-speed ferries. These applications share the public safety mandate that applies to aircraft operations[15] – the GNSS signals must be continuously available without disruption due to interference. Unlike GPS receivers located on landing aircraft, however, these receivers are likely to be operated in close proximity to or even on a co-location basis with MSS mobile earth terminals. In other words, none of the three conditions under which the OOBE levels proposed by NTIA and the Commission would "protect" GPS are present.

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[15] To the extent that the Commission focuses its inquiry in the *NPRM* almost exclusively on aeronautical radionavigation-related requirements, and either tacitly presumes that what is sufficient to protect GNSS would protect all other uses of GPS or ignores the broader safety-related applications of GPS altogether, the *NPRM* suffers from a glaring defect. There is no discernable rational basis for an OOBE limitation on MSS METs that is designed only to prevent interference with aircraft reception of satellite radionavigation signals in the 1559-1605 MHz band. *See* FCC 99-37, slip op. at 19 (¶ 44). There are millions of non-aeronautical, public safety users of GPS that must be accounted for as well.

As indicated above, the Council is prepared, due to the significant incentives that both the MSS and the RNSS industries have to ensure their respective abilities to operate in the adjacent RNSS/MSS bands at around 1.6 GHz, to accept the –70 dBW/MHz OOBE limit in the band 1559-1605 MHz for MSS mobile earth terminals operating in the 1610-1660.5 MHz band. This position represents substantial risk for GPS, but the integrity of the Commission's rules for the Big LEO MSS service and associated provisions serve to keep the risk within tolerable levels. Nevertheless, and for all the reasons that are provided below, the Commission must carefully reevaluate the proposals it has presented in the *NPRM.* Under no circumstance can the Commission adopt:

- any provision that would permit at any time a wideband OOBE level greater than –70 dBW/MHz in the 1559-1605 MHz band from MSS mobile earth terminals operating in the 1610-1660.5 MHz band; or

- any provision or policy that does not expressly establish that the –70 dBW/MHz OOBE limitation suggested here for the 1559-1605 MHz band is limited exclusively to MSS mobile earth terminals operating in the 1610-1660.5 MHz band.

With regard to the second bullet above, the Council observes that other emitters (even other MSS mobile earth terminals in bands outside the 1-3 GHz range) do not necessarily share the incentives for mutual operation that are present for the 1-3 GHz MSS services. In each such case, the Commission must insist that any limits on OOBE into the 1559-1605 MHz band be ascertained on a case-by-case basis following credible independent studies of all relevant factors (including interservice and intraservice aggregate interference levels, and the impact of harmonic emissions, separation distances, and shielding). In other words, the Commission must clearly rule that the –70 dBW/MHz OOBE level is not a protection criterion for GPS, nor is it a

level to be applied by default to any service other than the 1-3 GHz MSS METs in lieu of separate study.

In short, any Commission determination in this or any other proceeding that does not include all of the factors just outlined would jeopardize the GPS system and the millions of users worldwide who are relying on its continuous availability.

II. STATEMENT OF INTEREST

The U.S. GPS industry Council is a non-profit 501(c)(6) industry trade association whose mission is to be an information resource to the Government, the media, and the public on GPS. The Council's purpose is to promote sound policies for the development of commercial markets in civilian application, while preserving the military advantages of GPS. Current membership includes the principal U.S. manufacturers of GPS equipment – *e.g.*, Boeing, Honeywell, Magellan/Ashtech, Rockwell International, and Trimble Navigation.

The Council represents a significant sampling of the hundreds of manufacturers of GPS equipment and the millions of users of GPS signals. On behalf of its members, many of whom are engaged in activities with safety-of-life implications, the Council is extremely concerned that if the Commission were to adopt its proposed emission standards without considering all the operational and technical variations, it would lead to the loss of GPS signal reception or errors in position or time accuracy. Either of these consequences is intolerable for a safety-of-life service.

III. DISCUSSION

A. The Commission's OOBE Proposal Must Be Considered In Light Of The Strong, Congressionally-Dictated Commitment Of The United States To The GPS System.

The U.S. has made an unequivocal and strong commitment to the "continuous availability of GPS." This commitment, "addressing a *broad range* of military, civil, commercial, and scientific interests, both national and international" was announced in a Presidential Decision Directive ("PDD") of March 29, 1996.[16] Congress endorsed this commitment in statute with the Defense Authorization Act of 1998 ("PL 105-85") that was signed into law by the President.

PL 105-85 further provides that "[t]he Secretary of Defense shall provide for the sustainment and operation of the GPS Standard Positioning Service for peaceful, *civil, commercial, and scientific uses* on a continuous worldwide basis". GPS has never been defined, or limited to, an aeronautical service only. To treat it as such for purposes of frequency management is contrary to the letter and intent of Presidential policy and public law. Consequently, this *NPRM* provides an important regulatory opportunity to faithfully carry out the intent of law and policy to protect the broad range of millions of non-aviation users of GPS. In any event, the regulations cannot be limited to aeronautical purposes only.

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[16] *See* The White House, Office of Science and Technology Policy, National Security Council, Fact Sheet: U.S. Global Positioning Systems Policy, March 29, 1996, Pages 1-3 (Reference: Presidential Decision Directive NSTC-6).

The Commission's proposal to adopt a "one size fits all" regulatory standard creates three problems: 1) it ignores the operational reality in which GPS already exists; 2) it invites the proliferation of other services or devices, without requiring the essential advance studies of the operational consequences for GPS users, and thereby ignores the central issue of the impact on the aggregate noise floor in the GPS frequency band; and 3) it ignores the fundamental reality that attempting to limit the interference at the GPS receiver is not possible with the GPS architecture. Once the damage has occurred, historical experience shows that it is difficult to impossible to "clean the band" by removing the harmful interference sources. There are no practical remedies other than limiting the noise at the emitter; changes to the established GPS architecture are not possible. This would involve creating and funding a new space system, finding a new global spectrum allocation in already allocated international spectrum environment, worldwide recertification for aviation safety, and replacing millions of receivers owned by government and industry worldwide – options that are clearly not possible in today's complex domestic and international technical and political environments.

Congress further directed the Administration to "protect the integrity of the Global Positioning System frequency spectrum against interference and disruption" in the Defense FY99 Appropriations Conference Report and in the Commercial Space Act of 1998.[17] All users of GPS rightfully rely on these commitments, as do makers of GPS equipment for public safety, commercial, and infrastructure applications. Unless the specific protection

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[17] H.R. 105-746, Defense FY99 Appropriations Conference Report; H.R. 1702 Commercial Space Act of 1998.

measures the Council details in these Comments are taken by the Commission, the proposals in the NPRM will undercut these commitments and fatally compromise the integrity of the GPS system.

B. Results Of Studies Show That The Operation Of 1-3 GHz MSS Mobile Earth Terminals At OOBE Levels Of –70 dBW/MHz Or Higher Would Cause Substantial Interference To GPS Receivers In Many Applications (Both Safety Of Life And Otherwise) In The 1559-1605 MHz Band.

Stating that it is acting in accordance with the NTIA Petition for Rule Making, the Commission has proposed to require MSS earth terminals that are placed in service on or after January 1, 2002 in the bands 1610-1660.5 MHz to suppress the e.i.r.p. density of wideband emissions to –70 dBW/MHz or less in the band 1559-1605 MHz and to suppress the e.i.r.p. of discrete emissions of less than 700 Hz bandwidth (i.e., narrowband emissions) to –80 dBW in the same band.[18] For the period prior to January 1, 2005, the Commission proposes that MSS earth terminals that were placed in service in the band 1626.5-1660.5 MHz before January 1, 2002 would have to meet the –70 dBW/MHz limit on emissions in the band 1559-1580.42 MHz and to meet the –80 dBW/MHz narrowband limit on emissions in the band 1559-1585.42 MHz.[19] Finally, the Commission proposes that "Big LEO" MSS earth terminals (*i.e.*, MSS transmitting earth terminals operating with non-geostationary MSS systems on assigned frequencies in the band 1610-1626.5 MHz) that are placed in service before 2002 may, until January 1, 2005, meet

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[18] *NPRM*, FCC 99-37, slip op. at 27 (¶ 62).

[19] *Id.*

an interim limit of –64 dBW/MHz on wideband emissions in the band 1580.42-1605 MHz and an interim limit of –74 dBW on narrowband emissions in the band 1585.42-1605 MHz.[20]

As an initial matter, the Council notes that even if it could be hypothesized for sake of argument that the -70 dBW/MHz OOBE specification that has been recommended by NTIA would provide sufficient protection for GPS receivers – and the Council shows below why it cannot – there is no rational basis either for allowing a higher interference level before January 1, 2002 or for limiting the bands within which protection from wideband OOBE is provided to a band that does not reflect today's GPS operations. If -70 dBW/MHz were the maximum allowable emissions standard, there clearly would be interference from emitters that operate in the same bands at levels greater than –70 dBW/MHz. Moreover, many classes of GPS receivers in commercial and civil use employ the system's "Y" code, which extends to 1585.65 MHz at its upper end – *i.e.*, 10.23 MHz from the GPS center frequency of 1575.42 MHz. Any standard, interim or permanent, that does not limit both wideband and narrowband OOBE at least in the band extending ±10.23 MHz from 1575.42 (*i.e.*, from 1565.19 MHz to 1585.65 MHz) is, by definition, irrational.

The Commission must ensure that the GPS public safety applications are always protected. There is simply no room for interim emissions standards that pose an even greater interference threat to GPS than that which is represented by MSS METs operating or to be operated in the 1610-1660.5 MHz band (and for which the Council has accepted that operational considerations are envisioned to compensate for the inadequacies of the –70 dBW/MHz OOBE

level). Therefore, and in addition to all of the other recommendations the Council advances below, under no circumstance can the Commission adopt any provision that would permit a wideband OOBE level greater than –70 dBW/MHz from any emitter (MSS METs or otherwise) at any time.

The Council has long maintained, in various Commission proceedings, that the –70 dBW/MHz OOBE level is inadequate to ensure the protection of GPS receivers.[21] By "protection," the Council is referring to a level of OOBE at which GPS receivers that are already tracking the system's satellites remain able to do so, and at which those GPS receivers that are attempting to acquire signals from GPS satellites are able to do so.

Until now, much of what the Council has argued has been based on preliminary internal test results and, for lack of a better term, logic. The ability to do empirical testing has been hampered by the commercial unavailability of emitters (namely Big LEO METs) that would operate at or near the –70 dBW/MHz OOBE level in the GPS L1 band (*i.e.*, 1555-1610 MHz). The Council was not prepared to rely for such an evaluation on simulations that did not at least approach real world operating conditions. The "logical" element of the Council's contentions stems from the realization that an OOBE standard that was based on protecting GPS

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[20] *See id.*

receivers that operate under three very specific conditions (see page 5, *supra*) cannot logically be presumed – without more – to provide protection to those same receivers in any situation where all three of these conditions are not met.

Over the last several months, the Council has been conducting a series of tests on OOBE in the GPS band under conditions that it believes reliably replicate real-world conditions. In this respect, the tests performed have been kept as simple and straightforward as they can be and still retain scientific validity, in order to be readily comprehended by as broad a cross-section of interested user groups as possible. Furthermore, the tests were not designed to produce a skewed, "worst-case" set of results, but instead to produce results that are objectively representative of what actual GPS users would experience and understand.

The test program, methodology, and results are presented in Attachment 1 to these Comments. The principal goal of the Council's test program was to determine the susceptibility of a variety of RNSS receivers to the effects of interference from a white noise test source radiating from a near-isotropic antenna with an effective isotropic radiated power ("EIRP") of –70 dBW/MHz into the RNSS bands in situations likely to be encountered in non-aviation

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[21] *See, e.g.*, U.S. GPS Industry Council Petition to Deny AirTouch Satellite Services US, Inc., Application for Blanket Authorization to Construct and Operate Mobile Satellite Earth Terminals ("METs") in File No. 1367-DSE-P/L-97, at 10-11 (filed June 19, 1998); Petition for Reconsideration Regarding the Application of U.S. Leo Services, Inc. for Consent to the Assignment of a Blanket Earth Station License to Iridium U.S., L.P., in File No. 1044-DSE-AL-98, at 3-4 (filed August 31, 1998); Comments of the U.S. GPS Industry Council on the Commission's Proposal to Adopt Procedures for the Certification of Ground Segment Equipment for Use in the Provision of Global Mobile Personal Communications Services by Satellite ("GMPCS"), GEN Docket No. 98-68, at 6-7 (filed July 27, 1998).

operational settings (such as those where GPS receivers and the subject emitters are co-located in vehicles or boats using GPS for navigation). The following questions were examined:

- At what distance from the noise source does an RNSS receiver start to experience an impairment, such as the onset of loss of ability to track one satellite?

- At what distance from the noise source does an RNSS receiver recover the ability to track all of the satellites originally available?

Tests were conducted employing five different civil, commercial, and military GPS receivers from multiple manufacturers. At an OOBE level of –70 dBW/MHz in the RNSS band, receivers lost tracking on the first GPS satellite at a distance of more than 20 meters (65 feet) on the high end, and a distance of 2 meters (6.5 feet) or so on the low end. The distance at which the receivers were able to reacquire all of the originally available satellites ranged from about 7 meters (23 feet) on the lower end to 19 meters (63 feet) on the upper end. The bottom line: under a virtual co-location situation, where the GPS receiver is one meter or less from the noise source, an OOBE level of –70 dBW/MHz completely prevented the studies receivers from tracking and securing position fixes from GPS satellites.[22]

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[22] The practical impact of the test data is reflected in the following examples:

- Wideband receivers (centimeter accuracy) are affected. In two cases, two different receivers experienced a loss of tracking of the first satellite at 12 meters separation from the test source. Survey receivers are representative of the type of GPS receivers being used in machine control and mining operations. 12 meters means that construction crews on highways traveled by users of MES handsets or other sources of equivalent noise output will be affected.
- In-vehicle navigation systems are severely affected at 4 meters (13 feet). It is easy to envision adjacent automobiles in which an interfering source in one vehicle is travelling near enough to another vehicle that the second vehicle's navigation system would be rendered useless.

After obtaining these results, the Council went on to ascertain the OOBE level at which a co-location standard could be established. At an OOBE level of –85 dBW/MHz, four of the nine tested receivers lost tracking of GPS satellites at distances as far out as seven meters from the noise source. While this is an improvement over the situation from –70 dBW/MHz, it is clearly inadequate (as all of the tested receiver types are in widespread use today, and will remain so for the foreseeable future). Only after the OOBE level was dropped to –100 dBW/MHz in the GPS band was it the case that all of the tested receivers maintained tracking of all satellites at distances of one meter from the noise source.

Only one of the tests (at the –85 dBW/MHz level) evaluated the impact of multiple (in this case, two) noise sources on the GPS receivers. When two noise sources were used to assess the interference effects on the five tested receivers, there was a significant impact on the number of satellites tracked in each case. Tests were conducted at distances of four meters and three meters, respectively. At four meters, the number of satellites lost when a second noise source was turned on ranged from one of eight (12.5%) in the mildest case, to six of six (100%) in the most severe. As the distance was decreased to three meters, the number of satellites lost when a

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- Handheld units are affected at 9 meters. The general public is beginning to rely on GPS as a safety tool, as mentioned in an article in Sports Trend magazine (p. 75), May 1999 entitled "Safety Feature Igniting GPS Sales." In the Key Trends in GPS box, the author states: "Consumers view GPS as a safety tool, a major selling feature." The kind of interference caused by the –70 dBW/MHz OOBE will ultimately cause a deterioration in the availability of the GPS signal and will result in a loss of confidence by the public in GPS.
- General Avionics equipment is severely affected, and could not operate if the OOBE from a communications device were operating in the same cockpit of a private airplane. This is true for both in-dash mounted equipment and handhelds, as are commonly available today.

second noise source was turned on ranged from three of seven in the mildest case, to six of six and five of five (each 100%) in the two most severe cases. *See* Attachment 1 at page 11.

In short, based on the tests conducted by the Council, aggregate OOBE levels not exceeding –100 dBW/MHz in the GPS band would appear to provide the requisite protection of GPS receivers. OOBE levels of –70 dBW/MHz, for any emitter other than MSS METs operating in the 1-3 GHz band (which are in a special circumstances) clearly and objectively do not adequately protest GPS.

C. Even The Post-2005 OOBE Limits That Have Been Proposed In The *NPRM* Are Insufficient, By Themselves, To Protect All GPS Operational Situations.

In the NPRM, the Commission proposes that, as of January 1, 2005, the OOBE limits of -70 dBW/MHz on wideband and –80 dBW/MHz on narrowband emissions in the 1559-1605 MHz band would also apply to MSS terminals transmitting on frequencies between 1610 and 1660.5 MHz that are placed in service *before* 2002.[23] These proposals for "final" or permanent OOBE limits are based on recommendations made by the NTIA in a September 1997 petition for rule making that is now part of this proceeding.[24]

The Commission requests comment on the assumptions underlying NTIA's recommendations.[25] At the outset, the Council notes that the fact that the proposed limits are based on the NTIA recommendations is directly responsible for the principal shortcoming of the

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[23] *Id.*

[24] *See NPRM*, FCC 99-37, slip op. at 26 (¶ 61).

[25] *See id.* at 27 (¶ 62).

NPRM. The reason for this, as noted above, is that the NTIA petition was limited exclusively on "approach, landing, and surface operation" of aircraft, and thus does not cover the myriad other aviation, land, and marine situations where GPS is in current use in public safety and critical navigation situations.[26]

The NTIA recommendation was intended to protect GPS receivers in a one specific scenario – as such, the proposed standards cannot be presumed, without independent study and confirmation to provide adequate protection in scenarios where the assumptions are inapplicable.[27] In the specific case for which the NTIA proposal was developed, the victim GPS antenna was located on the top of an airplane fuselage and pointed up toward the satellite, and the aircraft fuselage shielded the antenna from any single interfering MSS MET located on the ground as the plane passed overhead.[28] Moreover, the MSS user – a single, ground-based omnidirectional transmitter – was assumed to be at least 30 meters (100 feet) away from the GPS antenna at the time the aircraft is most vulnerable and sensitive to interference.[29]

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[26] NTIA Petition For Rule Making (Page 1 of enclosure).

[27] The Council, for example, has questioned the suitability of the proposed -70 dBW/MHz emission limit to protect GPS from emissions from such distant interfering sources as RF lighting devises that are contemplated for operation in the 2.4 GHz band. *See* Reply Comments of the U.S. GPS Industry Council on RF Lighting Devices, ET Docket No. 98-42, at 4 (filed August 25, 1998).

[28] *See* "Assessment of Radio Frequency Interference Relevant to the GNSS," Document No. RTCA/DO-235 (January 27,1997).

None of the distance, shielding, and MSS earth terminal assumptions apply in any of a number of critical land and marine safety-related applications – and not even in other aeronautical scenarios – where mobile GPS receivers and mobile MSS transceivers can be expected to interact. Further, there is no proof whatsoever that the NTIA criteria are effective in situations where all three of the conditions above do not exist. Indeed, GPS receivers are used in ambulances, police cars, fire engines, for harbor-harbor entrance navigation, search and rescue, and docking of large marine vessels, such as oil tankers and high-speed ferries. These applications share the public safety mandate that applies to aircraft operations – the GNSS signals must be continuously available without disruption due to interference. Unlike GPS receivers located on landing aircraft, however, these receivers are likely to be operated in close proximity to or even on a co-location basis with MSS mobile earth terminals. In other words, none of the three conditions under which the OOBE levels proposed by NTIA and the Commission would "protect" GPS are present.

In fact, the adoption of the proposed emissions limits of the *NPRM* would result in the disruption of all GPS applications, whether land or air based, and whether safety-related or not. This is so because GPS satellites broadcast a very low power, one-way, signal. The received signal power only supports a data rate of 50 bits per second. The GPS signal comes from satellites that are 11,000 miles away providing very lower power flux densities at the

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[29] *See id.* A separation of 30 meters results in an attenuation of the MSS signal due to path loss of 66.1 dB. The airframe blocking results in a differential antenna gain of at least 5.5 dB. It is also noted that the –70 dB assumption was based on continuous tracking, not reacquisition, which can occur in urban canyons and crowded harbors. In these cases, the necessity for reacquisition is triggered by the physical topology.

earth's surface. This means that the GPS signals are inherently susceptible to OOBE generated locally. This problem is aggravated by the mobile nature of the use of the proposed system.

Moreover, the basic GPS system architecture has been unchanged since its conception in 1973. It is a characteristic of the GPS system itself, and no retrofit of the receivers, itself impractical, could enable continuous availability in the proposed interference environments.[30]

In sum, emission levels proposed in the *NPRM* do not, by themselves, protect GPS receivers that are likely to be operated in close proximity to multiple MSS METs terminals. Continuity is an operational requirement for a broad range of commercial and public safety users of GPS. In the absence of suitable arrangements for co-location operations (such as the ones under development between GPS and 1-3 GHz MSS operators), close proximity interference to GPS receivers at any of the levels proposed in the *NPRM* would end the continuous availability of GPS.

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[30] The Commission's NPRM repeats the contention of one satellite operator that, before imposing additional restrictions on MSS terminals to protect GPS, the Commission should require manufacturers and users of GNSS receivers to minimize their susceptibility to interference. *See* FCC 99-37, slip op. at 31 (¶ 75). This assertion relies on the mistaken impression that the susceptibility of GPS receivers to out-of-band noise is a function of the receiver design. Rather, the susceptibility is unrelated to the receiver design, and is strictly a function of the low level of the satellite signal.